Remarks/Arguments

This response is to the Office Action dated April 30, 2007.

Claims 2, 5-8 and 10 remain in this application.

During an Examiner initiated interview, as well as in the Interview Summary in the Office Action dated April 30, 2007, the Examiner suggested to Applicant that the claims would be allowable if Applicant amended the claims such that the claimed integral gasket was formed from "Santoprene®" (one example of a thermoplastic elastomer disclosed in the specification), rather than formed from the currently claimed "one or more thermoplastic elastomers". In addition, the Examiner is requiring that Applicant submit evidence/affidavits to support introduction of the actual chemical composition of Santoprene® because Applicant did not disclose this information in the specification as originally as filed.

Applicant respectfully contends that the claims are commensurate in scope with the enabling disclosure of the specification. The specification as originally filed provides support for each of the claim elements, including an integral gasket formed of a thermoplastic or thermoplastic elastomer. The specification teaches that the integral gasket or seal is formed of any elastomeric material, wherein the preferred elastomeric material has a durometer of from about 60 to about 100. The specification teaches that suitable elastomeric materials include, but are not limited to, thermoplastics and thermoplastic elastomers. By way of example, the specification teaches a specific thermoplastic elastomer, Santoprene®, having a durometer of about 80 and available from Advanced Elastomer Systems of Akron, Ohio. (see page 10, and Example 1 on page 12, of the specification)

Applicant respectfully contends that Santoprene® and "thermoplastic elastomers" are each well known and commonly used in the art. Applicant conducted a specification and a claim search for Santoprene® on the USPTO's Patent and Full Text Database and came up with 1601 hits. In

addition, a similar search was conducted for "thermoplastic elastomers" and Applicant came up with 9424 hits.

One of the hits, US 5,021,475 issued on June 4, 1991 to Isayev, contained both Santoprene® and thermoplastic elastomers. Isayev teaches that Santoprene® (from the Monsanto Company of St. Louis, Mo.) is a fully vulcanized thermoplastic elastomer comprising a blend of an ethylene-propylene diene monomer (EDPM) and polypropylene. According to "The Condensed Chemical Dictionary," 10th Ed., revised by G. G. Hawley, published by Van Nostrand Reinhold Co., 1981, pg. 413, EPDM is a terpolymer elastomer made from ethylene-propylene-diene monomer. The diene is preferably nonconjugated and may be, for example, a cyclic or aliphatic diene such as hexadiene, dicyclophentadiene or ethylidiene norbornene. The unsaturated part of the polymer molecule (e.g. the diene) is pendant from the main chain, which is completely saturated and essentially linear. (col. 2, lines 7-36)

Another hit, US 5,595,164 issued on September 28, 1999 to Campbell contained Santoprene® and thermoplastic vulcanizate ("thermoplastic vulcanizate" and "thermoplastic elastomer" are interchangeably phrases, see US 6,579,944 B1 to Abdou-Sabet et al., at col. 1, lines 12-17). Campbell teaches thermoplastic vulcanizates that are commercially obtainable, such as Santoprene® (from Advanced Elastomer System, Akron, Ohio), which comprises a polypropylene resin component and an EPDM rubber component both having been subject to curing. (col. 2, lines 53 to 67)

Other hits, by way of example only and not exhaustive of the all hits found, that contained both Santoprene® and thermoplastic elastomer include US 5,626,369 issued on May 6, 1997 to Shifman et al. , see col. 4, lines 12-18; and US 6,646,084 B2 issued on October 15, 2002 to Pulek, see col. 7, lines 17-45.

While hit US 5,443,906 issued on August 22, 1995 to Pihl et al. teaches that "thermoplastic elastomers": [a]re defined and reviewed in Thermoplastic Elastomers, A Comprehensive Review, edited by N. R. Legge, G. Holden and H. E. Schroeder, Hanser Publishers, New York, 1987 (referred to herein as "Legge et al" portions of which are incorporated by reference herein below). Thermoplastic elastomers (as defined by Legge et al. and used herein) are generally the reaction product of a low equivalent weight polyfunctional monomer and a high equivalent weight

polyfunctional monomer, wherein the low equivalent weight polyfunctional monomer is capable on polymerization of forming hard a segment (and, in conjunction with other hard segments, crystalline hard regions or domains) and the high equivalent weight polyfunctional monomer is capable on polymerization of producing soft, flexible chains connecting the hard regions or domains. This type of material has not been suggested for use in abrasive filaments.

"Thermoplastic elastomers" differ from "thermoplastics" and "elastomers" (a generic term for substances emulating natural rubber in that they stretch under tension, have a high tensile strength, retract rapidly, and substantially recover their original dimensions) in that thermoplastic elastomers, upon heating above the melting temperature of the hard regions, form a homogeneous melt which can be processed by thermoplastic techniques (unlike elastomers), such as injection molding, extrusion, blow molding, and the like. Subsequent cooling leads again to segregation of hard and soft regions resulting in a material having elastomeric properties, however, which does not occur with thermoplastics.

Commercially available thermoplastic elastomers include segmented polyester thermoplastic elastomers, segmented polyurethane thermoplastic elastomers, segmented polyamide thermoplastic elastomers, blends of thermoplastic elastomers and thermoplastic polymers, and ionomeric thermoplastic elastomers.

"Segmented thermoplastic elastomer" as used herein, refers to the sub-class of thermoplastic elastomers which are based on polymers which are the reaction product of a high equivalent weight polyfunctional monomer and a low equivalent weight polyfunctional monomer.

Applicant has also provided hereto an additional definition of <u>thermoplastic elastomers</u> from the Encyclopedia of Polymer Science Engineering, 1985, vol. 2, pp. 398-400, wherein <u>thermoplastic elastomers</u> are defined in substantially the same manner as Legge defined them herein.

As to the Examiner's request that Applicant submit evidence/affidavits to support introduction of the actual chemical composition of <u>Santoprene®</u>, Applicant respectfully contends that <u>Santoprene®</u>, as previously discussed, is a well known and commonly used <u>thermoplastic elastomer</u> (TPE) (also known as a thermoplastic rubber, see the <u>Santoprene®</u> General Product Bulletin, published by Advanced Elastomer Systems)

based on EPDM rubber and polypropylene. "Santoprene®", which was originally developed by Monsanto in 1977, has been commercialized since 1981. Santoprene® is currently commercialized by Advanced Elastomer Systems (AES) of Akron, Ohio, a subsidiary of ExxonMobile. (see "Academic/Corporate Collaboration: Responding to Change", Calzonetti et al. 2005)

Applicant respectfully contends that the evidence provided herein demonstrates that Santoprene® is a commonly used and well known thermoplastic elastomer (TPE or thermoplastic rubber or thermoplastic vulcanizate) comprising a cured polypropylene resin component and an EPDM rubber component. Further the term "thermoplastic elastomer" is a term well known to one of ordinary skill in the art.

Applicant contends that the claimed integral gasket element formed from one or more thermoplastic elastomers is commensurate in scope with the enabling disclosure in the specification, and as such, the claims as currently presented are allowable. Therefore, Applicant respectfully contends that the claims should not be amended such that the integral gasket is formed from Santoprene® as required by the Examiner, but should remain as currently presented, that is, the integral gasket element is formed from one or more thermoplastic elastomers. Additionally, Applicant respectfully contends that evidence or affidavits to support introduction of the actual chemical composition of Santoprene® should not be required by the Examiner because Applicant has demonstrated that Santoprene® is a commonly used and well known thermoplastic elastomer.

Claims 2, 5-7 and10 have been rejected under 35 USC 102(b) in view of GB 2,302,042 A. Applicants disagree.

The present invention requires a **thermoplastic elastomer** as a gasket formed through the thickness of a screen and having a thickness greater than the screen through which it is formed.

The reference fails to teach each and every element of the present invention and as such is not an anticipatory reference. In particular, the reference fails to teach the use of a thermoplastic

elastomer that is formed through the thickness of the screen and which has a thickness greater than that of the screen through which it is formed.

The reference clearly teaches that an EVA copolymer is placed "between" the layers not through the screen layers. **See GB 2302042**, Abstract, line 3, "positioned between the elements"; Page 1 third paragraph "between the filtration medium and support material"; Page 2, line 9, "positioned between the structural elements" and line 35 "between"; Page 4, lines 27-28 "positioned between the filtration media"; Page 5, lines 1-2 "between the filtration media"; Page 6, lines16-17 "between the support materials"; line 34 "positioned between the membrane"; Page 7 lines12-13 " positioned between the membrane and the support material"; and claim1 line 5 "positioned between said structural elements".

Contrary to the statement made in the Office Action, it is clear that the reference fails to teach the gasket material being a thermoplastic elastomer as is known to one of ordinary skill in the art.

The office action also makes the statement that the copolymer is heat sealed and penetrates several layers, yet provides no citation to support this assertion and Applicants see none. They specifically ask that the examiner provide them with the citation upon which the examiner has relied for this assertion. While the material is described has preferably having a lower melting point than the other materials, there is no teaching or suggestion that it is in fact heat melted.

To the contrary, at Page 7, line 35 to Page 8, line7, the reference discusses the "excellent adhesion and compliance characteristics" of the copolymer. One of ordinary skill in the art would conclude that adhesion is the mechanism for attachment of the copolymer **between** the adjacent layers.

As the standard for anticipation is one of strict identity and "the reference must teach every aspect of the claimed invention either explicitly or inherently." (MPEP section 706.02IV, lines 6 and 7) and the cited reference has failed to teach the claimed elements of the present claims, this reference is not and cannot be an anticipatory reference. As such, the rejection based on 35 USC 102(b) is respectfully requested to be withdrawn as it fails to provide a reference which contains all of the claimed elements of the present claims and therefore no basis for rejection under 35 USC 102 has been properly made.

Likewise, the reference fails to teach or suggest the use of a thermoplastic elastomer and it would not have been obvious from the reference to one of ordinary skill in the art do so in view of its teachings. As such, it is believed the prima facie case of obviousness has been rebutted and the rejection should be withdrawn.

Claims 2, 5-8 and 10 have been rejected under 35 USC 103(a) over Rogemont (US 4,701,234) in view of the GB reference. Applicants disagree.

The office action states that Rogemont fails to teach or suggest a thermoplastic elastomer but that the GB reference does and that it would have been obvious to substitute the EVA copolymer of the GB reference for the raw, cured in place silicone of Rogemount. Applicants disagree.

The office action's position is based upon the disclosure in the GB reference that its EVA copolymer has low extractables and layers can be sealed together into one body using the material. The Office Action fails to consider the clear teaching that the EVA layer of the GB reference is used between layers of the device and it uses its good adhesive properties to bond the layers together or that Rogemount uses raw silicone and then uses compression and heat to cause the raw material to penetrate the mesh and then polymerize.

What teaching is present to motivate one skilled in the art to use the EVA material of the GB reference in the process of Rogemount? The skilled artisan would have to ignore the teachings of the GB disclosure regarding the placement of the EVA between the layers and using its excellent adhesion properties to hold the layers together, focus only on the EVA material itself, and somehow arrive at the conclusion that it could be compressed under pressure and heat as taught by Rogemount to fill the mesh of Rogemount. EVA is a thermoplastic not a thermoplastic elastomer as is claimed in the present invention. Additionally, in the Rogemount process, the heat used to polymerize the raw silicone would cause the EVA copolymer to melt and flow in uncontrollable ways and not form the seal between the layers as it had in the GB reference. One of ordinary skill in the art would not have been suggested or motivated to use the GB EVA in the Rogemount process as suggested in the present office action.

As stated by the Federal Circuit in *In re Fine*, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1986), "One cannot use hindsight reconstruction to pick and choose from isolated disclosures in the prior art to deprecate the claimed invention."

Of similar import is *In re Wesslau*, 147 U.S.P.Q. 391, 393 (CCPA 1965):

> "It is impermissible within the framework of section 103 to pick and choose from any one reference only so much of it as will support a given position <u>to the exclusion of other parts necessary to the full appreciation of what such reference fairly suggests to one skilled in the art.</u>" (Emphasis added).

The combination of the two references would not have led to the claimed invention. At best the cited combination would have led to the use of the polymerizable thermoset silicone of Rogemont in the device of the GB reference or the use of the EVA layer between the various layers, relying on the "excellent adhesion" of the EVA to bond the layers together rather than the

molding and heating of Rogemount. However that is not the presently claimed invention. As such, it is believed the prima facie case of obviousness has been rebutted and the rejection should be withdrawn.

Reconsideration and allowance are respectfully requested in view of the foregoing amendment and remarks.

Respectfully submitted,

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Stacey Gross

Appendix A

Santoprene®
General Product Bulletin

Santoprene

THERMOPLASTIC RUBBER

Advanced Elastomer Systems

The worldwide leader in engineered TPEs

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INTRODUCTION

Santoprene® thermoplastic rubber is a family of high-performance elastomers which successfully combine performance characteristics of vulcanized rubber, such as flexibility and low compression set, with the processing ease of thermoplastics.

Santoprene rubber fits into the middle of the cost and performance spectrum of both thermoplastic and thermoset rubbers, as shown in Figure 1. Santoprene rubber offers the dual advantages of low-cost thermoplastic processing and vulcanized rubber performance. As a result, Santoprene rubber has found rapid acceptance in a broad variety of industrial and consumer-oriented rubber product applications.

The characteristics of Santoprene rubber offer new opportunities for product design engineers. Its unique combination of material properties and processing ease lets the processor achieve such critical goals as lower production costs, consistent quality and improved product performance in many applications.

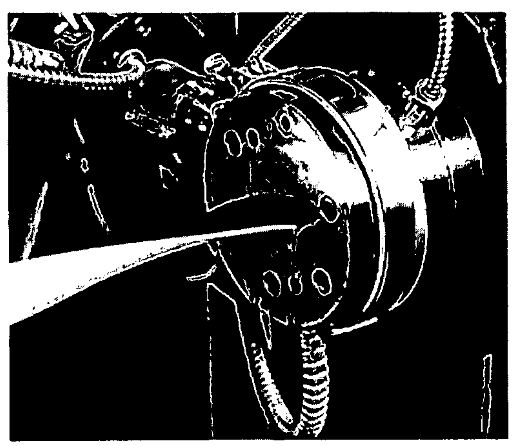
Santoprene rubber consists of highly crosslinked rubber particles dispersed throughout a continuous matrix of thermoplastic material. An average rubber particle size of 1 micron or less results in very favorable physical properties.

Santoprene rubber is processed on standard thermoplastic equipment. It can be injection molded, extruded, blow molded and thermoformed with the efficiency and economy associated with thermoplastic materials. Further, clean scrap from these processes can be recycled.

Santoprene rubber is available in hardness grades ranging form 35 Shore A to 50 Shore D, each with individual performance characteristics. This permits designers and processors to select the specific grade that matches their product requirements.

Santoprene rubber has high temperature resistance equivalent to general purpose EPDM rubber compounds, while fluid resistance is comparable to general purpose polychloroprene rubber compounds. This unique combination of high temperature and fluid resistance provides a thermoplastic rubber suitable for a broad range of applications.

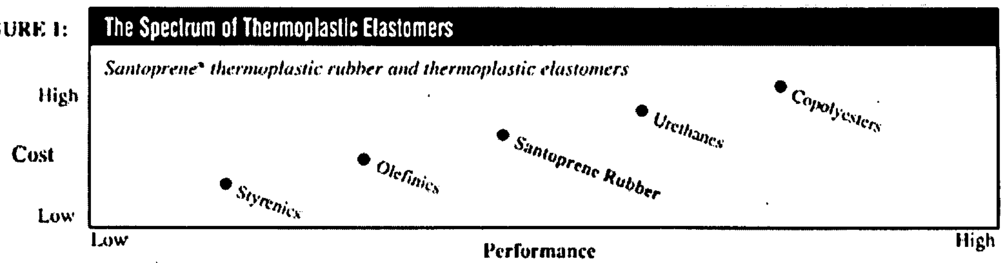
Santoprene® thermoplastic rubber is injection molded on conventional thermoplastic machines, including two-shot molding shown here.

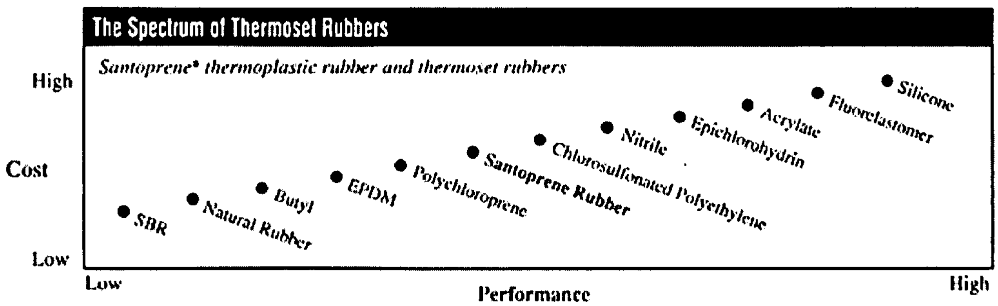


Extrusion of Santoprene® thermoplastic rubber is done on thermoplastic processing lines.

APPLICATIONS

FIGURE 1:





The broad spectrum of performance characteristics of Santoprene rubber makes it exceptionally well suited for processing into a wide variety of end-use applications. Some typical applications are given below:

• **Appliances:** pump gaskets, supports, boots, hose connectors, plugs, sump boots, baffles.

• **Automotive:** rack-and-pinion boots, air ducts, cable covers, bushings, windshield spacers, tubing, grommets, gaskets, body seals for windows and doors, body plugs, weather stripping, lamp covers, suspension dust covers, air bag doors.

• **Building and construction:** glazing gaskets, weather stripping for doors and windows, bulb seals, expansion joints, setting blocks.

• **Business machines:** rollers for printers, computer feet, vibration isolaters.

• **Electrical/electronic:** molded connectors, power transmission and distribution components, linemen's accessories, mining cable, control cable, power-limited circuit cable, submersible cable, coiled cords, flexible cords.

• **Fluid delivery:** plumbing seals, filter and pump seals, hose and tubing, pipe seals.

• **Food contact:** diaphragms, valve seals, closure seals, hose and tubing.

• **Hardware:** caster wheels, tool grips, industrial rollers.

• **Medical devices:** closures, gaskets, stoppers, plunger tips.

• **Sporting goods:** bat grips, rifle stock cushions, scuba diving equipment, ski pole handles.

This list is by no means comprehensive. Designers and materials engineers are continually expanding the uses for Santoprene rubber. The acceptability of Santoprene rubber for any specific application ultimately depends on the performance requirements. Thus, end-use performance testing should be conducted before products from Santoprene rubber are introduced commercially.

Performance and Product Characteristics of Santoprene Rubber

Performance

The performance characteristics of Santoprene rubber are similar to those of many vulcanized rubbers. These characteristics give product designers and materials engineers the opportunity to capitalize on lower-cost thermoplastic processing without sacrificing the desired product performance. Performance characteristics of properly processed Santoprene rubber include:

- Withstands transient temperatures up to 150°C (300°F) and continuous temperatures to 135°C (275°F) per SAE J2236.
- Fluid resistance similar to polychloroprene for aqueous-based fluids, oils and hydrocarbons.
- Low compression and tension set.
- Outstanding dynamic fatigue resistance.
- Good tear strength.
- Excellent ozone and good weathering resistance.

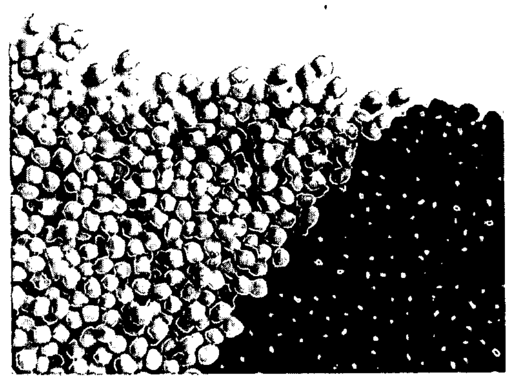
This combination of properties in a family of materials provides designers with a high degree of flexibility in product development. Advanced Elastomer Systems L.P. and its affiliates (AES) has developed a wide variety of specialty grades tailored to specific applications.

Processing Ease

Santoprene rubber is processed with conventional thermoplastic equipment to make extruded, injection molded, blow molded or thermoformed products. These thermoplastic characteristics pay off in fast, efficient processing times and complete scrap recycling.

Ready to Use

All grades of Santoprene rubber are supplied as fully compounded free-flowing pellets, prepared under strict AES quality control. They are ready to be used as received, without further compounding. Because Santoprene rubber is hygroscopic, pre-drying prior to processing is strongly recommended, especially for extrusion and blow molding, to minimize potential moisture-related problems such as porosity.



Santoprene® thermoplastic rubber is supplied in fully compounded pellet form.

A Wide Range of Available Grades

Santoprene rubber is available in hardness grades ranging from 35 Shore A to 50 Shore D. Depending on the grade selected, black or colorable pellets are available with no difference in mechanical properties, performance or processing between black and colorable grades of the same hardness. Each grade is identified by a five-digit product code which defines certain characteristics of the grade, as illustrated in Table I.

TABLE I: **How to read a Santoprene® Thermoplastic Rubber Product Code**

First Digit	Second Digit	Third Digit	Fourth and Fifth Digits
Pellet Color	Grade Type	Hardness Scale	Hardness Numerical Value
1 = Black	0 = General Purpose	1 = Shore A	Actual 5-second reading
2 = Colorable	1 = Molding	3 = Shore D	
	2 = UV Stabilized		
	4 = NSF		
	5 = Flame Retardant		
	7 = Food Contact		
	8 = Medical		
	9 = Specialty		

Some Examples:

101-73 = black general purpose Santoprene rubber, 73 Shore A.
103-50 = black general purpose Santoprene rubber, 50 Shore D.
201-73 = colorable general purpose Santoprene rubber, 73 Shore A.
211-45 = colorable molding grade Santoprene rubber, 45 Shore A.

General Purpose Grades		Molding Grades	
Black	Colorable	Black	Colorable
101-55	201-55	111-35	-
101-64	201-64	111-45	211-45
101-73	201-73	111-55	211-55
101-80	201-80	111-64	211-64
101-87	201-87	111-73	211-73
103-40	203-40	111-80	211-80
103-50	203-50	111-87	211-87
-	-	113-40	213-40

Meeting Special Requirements

Special purpose grades of Santoprene rubber are available to meet specialized needs, such as flame retardance, enhanced UV stability or food contact. For more information on using Santoprene rubber for special requirements, ask your AES representative.

Using Colorants

Santoprene rubber can be used in colorable or black pellets as supplied. Colorable Santoprene rubber pellets are typically used with standard polypropylene color concentrates to produce a wide variety of finished part colors. Dry pigment and liquid colors also may be used, but require special processing equipment.

Detailed Information Available

This bulletin primarily describes the general purpose grades of Santoprene rubber. Ongoing research, development and production line experience continues to expand our knowledge of Santoprene rubber, which is summarized in literature covering a broad range of individual topics. Ask your AES representative for literature specific to your application.

PHYSICAL PROPERTIES OF SANTOPRENE RUBBER

The physical properties of Santoprene rubber support its suitability as a cost-effective replacement for thermoset rubbers. The combination of mechanical properties, fluid resistance, flame retardance and hot air stability make Santoprene rubber suitable for a broad spectrum of end uses.

Like many thermoplastics, the results obtained for physical property measurements of Santoprene rubber depend on the method of sample preparation. Unless otherwise noted, all data are from injection molded plaques and properties are measured perpendicular to flow. Samples made from extruded sheet have slightly higher tensile strengths than samples made from injection molded plaques.

Mechanical Properties

The mechanical properties of Santoprene rubber are illustrated in Tables II and III. Advantages of these properties are noted below:

The available range of hardnesses of Santoprene rubber permits the design and manufacture of parts ranging from flexible to semi-rigid, while maintaining the broad range of favorable physical properties.

Specific gravity of Santoprene rubber is generally lower than compounded (filled), vulcanized specialty rubbers, such as polychloroprene, chlorosulfonated polyethylene and EPDM. Thus, on a unit volume basis, a smaller weight of Santoprene rubber would be needed for a specific part.

Tensile properties of Santoprene rubber – tensile strength, ultimate elongation and 100% modulus – vary by grade. The harder grades have higher tensile strength and elongation than the softer grades.

Tear strength of Santoprene rubber is good. It allows use in a wide variety of applications now employing conventional thermoset rubbers. The good hot-tear strength enables easy removal of molded parts from injection and blow molding equipment, thus permitting fast molding cycles.

Tension and compression set resistance of Santoprene rubber represents a major breakthrough for thermoplastic materials. Resistance to tension set after a 100% elongation is good for all grades of Santoprene rubber. Resistance to compression set after a constant deflection is excellent, particularly for softer grades at elevated temperatures and for extended periods of time. The low compression and tension set of the softer grades of Santoprene rubber make them well suited for many applications which previously were met only by vulcanized thermoset rubbers.

Flex fatigue resistance of Santoprene rubber is extremely high compared to many thermoset rubber compounds. The softer grades of Santoprene rubber are superior in fatigue resistance to natural rubber, even when the natural rubber is specially ompounded for high-fatigue resistance. Because of the great variety of flex fatigue applications, part redesign is generally required and the parts made from Santoprene rubber should be tested in the specific application.

Brittle point for general purpose grades of Santoprene rubber, except 103-50 and 203-50, is well below -40°C (-40°F). All hardness grades have good low-temperature flexibility.

TABLE II: Typical Mechanical Properties of Santoprene® Thermoplastic Rubber[1] (ASTM)

Properties	ASTM Test Method	Test Units SI (U.S.)	Test Temp. °C (°F)	Grades of Santoprene Rubber 35A	45A	55A	64A	73A	80A	87A	40D	50D
Hardness	D2240	5 Second Shore	25 (77)	35A	47A	56A	66A	74A	81A	88A	41D	50D
Specific Gravity	D792	—	25 (77)	0.95	0.96	0.97	0.97	0.97	0.97	0.96	0.95	0.94
Tensile Strength	D412	MPa	25	2.0	3.6	4.7	6.3	8.3	11.0	15.9	19.0	27.6[2]
		(psi)	(77)	(285)	(520)	(680)	(920)	(1200)	(1600)	(2300)	(2750)	(4000)[2]
Ultimate Elongation	D412	%	25 (77)	250	300	350	400	450	500	550	570	600[2]
100% Modulus	D412	MPa	25	0.9	1.6	2.0	2.6	3.5	4.7	6.9	9.3	10.0[2]
		(psi)	(77)	(130)	(230)	(290)	(380)	(510)	(680)	(1000)	(1350)	(1450)[2]
Tear Strength	D624	kN/m	25	10.2	12.9	19	24.5	27.8	34.0	48.7	64.6	90.0
		(pli)	(77)	(58)	(70)	(110)	(140)	(160)	(195)	(280)	(370)	(515)
		kN/m	100			7.3	10.2	13.1	13.3	23.3	35.5	63.7
		(pli)	(212)			(40)	(60)	(75)	(75)	(135)	(200)	(365)
Tension Set	D412	%	25 (77)	5	5	6	10	14	20	33	48	61
Compression Set 70 Hrs.	D395	%	25 (77)	20	13	23	23	24	29	29	32	41
168 Hrs.	Method B	%	100 (212)		22	25	36	38	41	45	49	81
Flex Fatigue[3]	D4482	Megacycles to fail	25 (77)			>3.4	>3.4	>3.4[4]				
Brittle Point	D746	°C	—	-60	<-60	<-60	<-60	<-60	<-60	<-60	-57	-29
		(°F)	—	(-76)	(<-76)	(<-76)	(<-76)	(<-76)	(<-76)	(<-76)	(-71)	(-34)

1. See Disclaimer on inside front cover.
2. Grades 103 - 50 and 203 - 50 have a yield point at 11.4 MPa (1650 psi) and 40% elongation. Stress-strain measurements for these grades are according to ASTM D638.
3. Monsanto Fatigue-to-Failure Test.
4. No failure at 3.4 million cycles. Test terminated.

TABLE III: Typical Mechanical Properties of Santoprene® Thermoplastic Rubber[1] (ISO)

Properties	Grades of Santoprene Rubber 35A	45A	55A	64A	73A	80A	87A	40D	50D
Hardness – 15 sec.[2]	41	50A	60A	70A	80A	87A	96A	41D	52D
Tensile strength (MPa)[3]	2.3	3.3	4.6	6.4	8.7	11.9	17.6	21.2	31.0
100% Modulus (MPa)	0.9	1.6	2.0	2.5	3.4	4.6	6.8	9.1	12.8
Elongation at break (%)	317	330	380	430	480	520	570	590	620
Tear strength (N/mm) / strong direction[4]	9.6	11.6	15.6	20.7	25.6	32.5	49.5	67.1	98.9
Tear strength (N/mm) / weak direction[4]	8.1	10.5	14.6	20.5	25.9	34.6	56.4	77.7	122.3
Compression set (%) / 168 hrs. at 23°C[5]	N/T	23	25	27	31	36	45	50	
Compression set (%) / 168 hrs. at 100°C[5]	N/T	25	28	32	37	44	55	62	

1. See Disclaimer on inside front cover.
2. Hardness according to ISO 868 (Shore A & D – 15 sec – Zwick tester).
3. Tensile properties according to ISO 37 (Strong direction – Type 1).
4. Tear strength according to ISO 34 (Type 1).
5. Compression set according to ISO 815 (sample type A; conditioning: 1 hr. at 140°C; Ø: 23mm / thickness: 12.5mm).
6. N/T = Not Tested

Fluid Resistance

The resistance of Santoprene rubber to heat and oil can be classified using the ASTM D2000/SAE J200 Standard Classification System for rubbers, as shown in Table IV.

Santoprene rubber offers fluid resistance equivalent to that of many specialty thermoset rubbers, such as polychloroprene compounds. A brief summary of the data for several fluids is given in Table V. These data show the excellent resistance of Santoprene rubber to aqueous fluids, including acids and bases.

Rubbers with hardnesses greater than 40 Shore D are not included in the ASTM D2000/SAE J200 classification system.

Additional fluid resistance data for all grades of Santoprene rubber are included in the AES "Santoprene Rubber Fluid Resistance Guide." Actual performance of parts made from Santoprene rubber in any specific application requiring fluid resistance is best determined by specific testing in that application.

TABLE IV: **Standard Classification Systems**

Grade	Type and Class
35A	AA, BA, BC, CA
45A	AA, BA, BC, CA
55A	AA, BA, BC, CA
64A	AA, BA, BC, BE, CA
73A	AA, BA, BC, BE, CA, CE
80A	AA, BA, BC, BE, BF, CA, CE
87A	AA, BA, BC, BE, BF, CA, CE
40D	AA, BA, BC, BE, BF, CA, CE

TABLE V: **Typical Fluid Resistance, % Weight Change of Santoprene® Thermoplastic Rubber ASTM D471[1]**

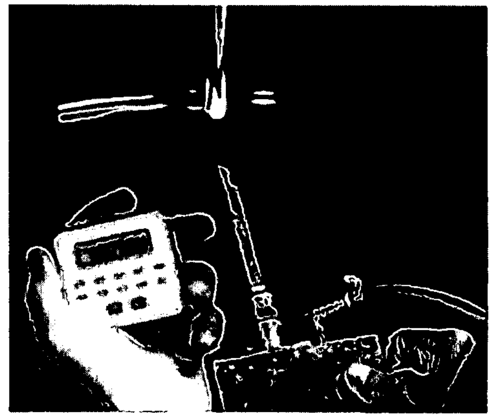
			Grades of Santoprene Rubber								
Fluid	Test Time (hours)	Test Temp °C (°F)	35A	45A	55A	64A	73A	80A	87A	40D	50D
Water	166	100 (212)	5	6	6	6	5	3	3	2	2
Antifreeze[2]	166	125 (257)	7	5	7	6	4	4	3	2	2
15% Salt (NaCl)	166	23 (73)	0	0	0	0	0	0	0	0	0
50% Sodium Hydroxide	166	23 (73)	0	0	0	0	0	0	0	0	0
98% Sulfuric Acid	166	23 (73)	2	5	3	5	4	3	2	2	0
IRM 902 Oil	166	100 (212)	N/T	77	69	58	42	37	21	16	12
IRM 903 Oil	166	100 (212)	108	102	94	80	61	55	35	29	24
ASTM #1 Oil	166	100 (212)	52	45	35	30	30	20	15	6	5
Sunvis 706[3]	166	125 (257)	90	77	58	58	55	44	40	30	27
Skydrol* 500 (B-4)[4]	166	100 (212)	-40	-32	-30	-26	-13	-8	-5	-1	-1
Pydraul* 312C[5]	166	125 (257)	30	29	18	19	22	18	18	15	14
DOT 3 Brake Fluid	166	100 (212)	-45	-37	-29	-30	-18	-14	-13	-9	-10
Automatic Transmission Fluid	166	125 (257)	87	88	62	62	59	47	43	33	31
Reference Fuel B	166	23 (73)	N/T	N/T	66	50	42	40	25	21	17
Lithium Grease166	166	100 (212)	61	50	43	39	33	23	19	11	10

1. See Disclaimer on inside front cover.
2. 50% by volume Prestone antifreeze in type IV reagent water. Prestone is a trademark of Union Carbide Corp.
3. Sunvis is a trademark of Sun Oil Company and is a lubricating oil.
4. Skydrol* is the registered trademark of Solutia for hydraulic fluid.
5. N/T = Not Tested
6. DOT 3 SAE J 1703

Flame Retardance[1]

All general purpose grades of Santoprene rubber support combustion in air. However, the burning rate is slow, and all grades will pass Federal Motor Vehicle Safety Standard No. 302 down to 1mm (0.040 in.) thickness. In addition, all of these grades, except 35A and 45A, are rated slow-burning when tested according to UL 94 HB. For applications requiring a thermoplastic rubber with enhanced resistance to the initiation and spread of fire, consider a flame-retardant grade of Santoprene rubber.

1. See Disclaimer on inside front cover.



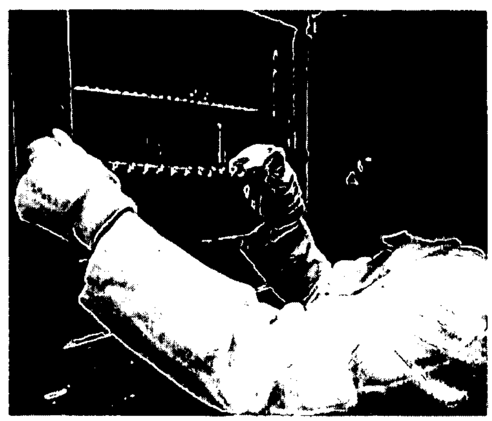
Flame testing proves the slow-burning characteristics of flame-retardant grades of Santoprene® thermoplastic rubber.

Environmental Stability

The environmental stability of Santoprene rubber is excellent, exceeding many thermoset rubbers. Table VI illustrates the retention of physical properties for Santoprene rubber grades 101-73 and 103-40 after exposure in a xenon arc weatherometer. The retention of tensile strength, ultimate elongation and 100% modulus after 2,000 hours exceeds 90% in all cases.

Many thermoset rubbers deteriorate when they have prolonged exposure to air, oxygen or ozone. Santoprene rubber is designed to be resistant to these gases, with its ozone resistance rated as outstanding. Testing according to ASTM D518 demonstrates that all grades surpass the required criteria after 96 hours in 50 pphm ozone at 40°C (104°F).

Extensive heat aging of thermoset rubber compounds frequently causes a severe change in mechanical properties. Table VII illustrates the retention of tensile strength, ultimate elongation and 100% modulus for Santoprene rubber after hot-air aging for up to 1,000 hours (41.7 days) at 135°C (275°F). Santoprene rubber shows less than 25% change in these mechanical properties at all conditions. This excellent hot-air aging represents a significant performance advantage compared to most thermoset rubber compounds. More data on heat aging is available in the AES "Santoprene Rubber Physical Properties Guide."



Santoprene® thermoplastic rubber has excellent heat-aging characteristics.

TABLE VI: Weatherability of Santoprene® Thermoplastic Rubber in Xenon Arc Weatherometer[1]

Percent retention of tensile properties after exposure (Method GM 9125P)

	Santoprene Rubber 101-73			Santoprene Rubber 103-40		
Time (hours)	Tensile Strength	Elongation	100% Modulus	Tensile Strength	100% Elongation	Modulus
1,000	103%	94%	104%	101%	98%	105%
2,000	102%	94%	106%	107%	100%	107%

1. See Disclaimer on inside front cover.

TABLE VII: Heat Aging of Santoprene® Thermoplastic Rubber[1] (ASTM D573 / D2240 / D412)

Retention of mechanical properties at 135°C (275°F)

Shore Hardness of Santoprene rubber Mechanical Property	1 Days (24 hours)	7 Days (168 hours)	15 Days (360 hours)	30 Days (720 hours)	41.7 Days (1,000 hours)
35A Change in hardness, Shore A units	-1	1	-1	-1	N/T
Tensile strength, % retention	82	83	77	75	N/T
Ultimate elongation, % retention	90	99	102	122	N/T
100% modulus, % retention	96	94	93	80	N/T
45A Change in hardness, Shore A units	0	0	+1	+3	+4
Tensile strength, % retention	96	103	101	95	95
Ultimate elongation, % retention	93	110	114	130	107
100% modulus, % retention	105	105	106	106	109
55A Change in hardness, Shore A units	+2	+3	+5	+3	+7
Tensile strength, % retention	92	101	99	80	88
Ultimate elongation, % retention	86	97	104	92	99
100% modulus, % retention	107	106	104	105	110
64A Change in hardness, Shore A units	0	0	0	+3	+3
Tensile strength, % retention	96	94	103	114	113
Ultimate elongation, % retention	89	89	94	101	101
100% modulus, % retention	103	106	103	108	110
73A Change in hardness, Shore A units	-1	-1	0	+2	+4
Tensile strength, % retention	94	100	105	120	108
Ultimate elongation, % retention	87	98	98	105	89
100% modulus, % retention	101	103	104	107	112
80A Change in hardness, Shore A units	- 1	- 1	0	+ 2	+ 2
Tensile strength, % retention	97	97	107	103	93
Ultimate elongation, % retention	92	89	98	83	73
100% modulus, % retention	106	110	112	116	122
87A Change in hardness, Shore A units	- 3	- 2	- 3	- 1	0
Tensile strength, % retention	95	94	99	96	85
Ultimate elongation, % retention	89	85	84	80	68
100% modulus, % retention	107	108	114	117	120
40D Change in hardness, Shore D units	- 1	- 1	+ 2	+ 3	+ 4
Tensile strength, % retention	99	97	98	97	94
Ultimate elongation, % retention	90	83	84	79	71
100% modulus, % retention	107	112	112	118	127
50D Change in hardness, Shore D units	0	0	+ 1	+ 3	+ 4
Tensile strength, % retention	99	101	99	93	93
Ultimate elongation, % retention	98	94	87	84	85
100% modulus, % retention	115	119	122	122	125

1. See Disclaimer on inside front cover.
2. N/T = Not Tested

Rheology of Santoprene Rubber

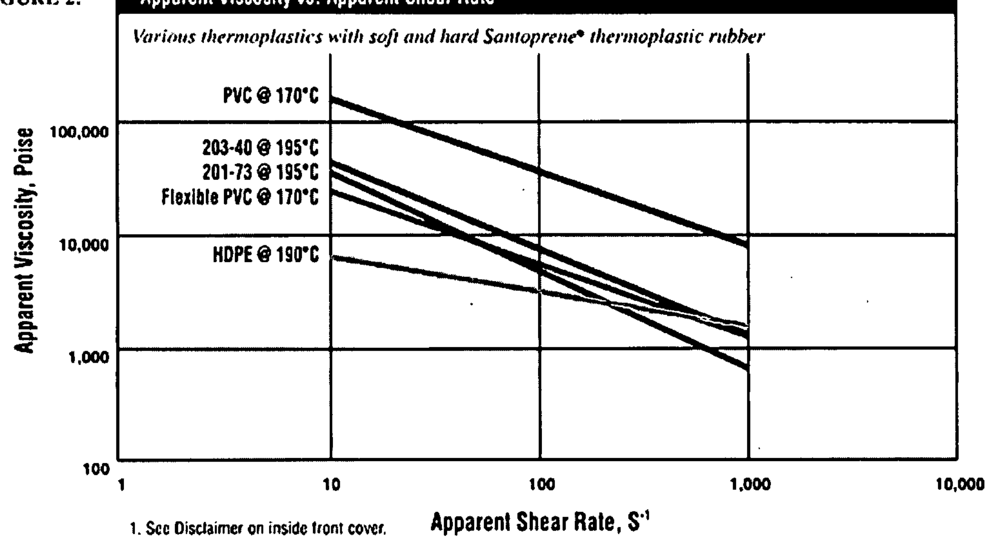
The melt viscosity of Santoprene rubber is highly dependent on shear rate. Figure 2 compares the viscosity at various shear rates of a soft and a hard grade of Santoprene rubber to typical molding grades of commonly known thermoplastics, such as rigid polyvinylchloride (PVC), plasticized PVC and high-density polyethylene (HDPE).

All grades of Santoprene rubber have high melt viscosity at low shear rates. In extrusion and blow molding, this high viscosity provides excellent melt integrity and permits the retention of shape during cooling. For injection molding, high injection pressure and fast injection times can lead to shorter overall cycle times.

The effect of temperature on the melt viscosity of Santoprene rubber is much lower than for other thermoplastic materials, in contrast to the effect of shear rate. Thus, a desirable melt viscosity will be more readily obtained by varying shear rate rather than temperature. For further information, consult the AES "Injection Molding Guide for Thermoplastic Rubber" and "Guide for Extrusion for Thermoplastic Elastomers."

FIGURE 2: **Apparent Viscosity vs. Apparent Shear Rate**[1]

Various thermoplastics with soft and hard Santoprene® thermoplastic rubber



1. See Disclaimer on inside front cover.

Processing of Santoprene Rubber

Recommendations for the storage and processing of Santoprene rubber are covered in detail in the processing guides for individual processes. Highlights of these recommendations follow. For complete details, ask your AES representative.

Storage and Handling

Santoprene rubber is supplied in pellet form. Thus, handling is relatively easy. Santoprene rubber is shipped in sealed packages which have a built-in moisture barrier. Packages should not be left open, since the material will absorb significant amounts of ambient moisture.

Santoprene rubber is heat stable at temperatures up to 246°C (475°F) and does not evolve gaseous by-products when used under recommended processing conditions. However, good ventilation should be provided when processing any material.

Good standard safety practices must be followed when processing Santoprene rubber in the melt to prevent personal injury caused by contact with the hot polymer system.

Thoroughly purge processing equipment with polyolefin polymers, including polypropylene, when using the same equipment to process Santoprene rubber and acetal resins, halogenated polymers and phenolic resins. Do not mix Santoprene rubber, acetal resins, halogenated polymers or phenolic resins at elevated temperatures.

All grades of Santoprene® thermoplastic rubber are shipped in 25-kg (55-pound) bags with moisture barriers for added protection.

Drying

Because of the hygroscopic nature of Santoprene rubber, drying in a dehumidified hopper dryer or a vacuum oven is strongly recommended, especially for extrusion and blow molding.

First bring the dryer temperature up to 80°C (180°F). When this temperature is reached, the Santoprene rubber should be held in the dryer for a period of 3 hours. Timing of the drying cycle should not begin until after the dryer temperature is reached.

Exposure to high relative humidity should be avoided, since moisture pickup can cause voids in the processed product. Once processed, however, exposure to high humidity will not affect the physical properties.

For additional drying information, refer to the AES "Injection Molding Guide for Thermoplastic Rubber."

Pre-drying is recommended for Santoprene® thermoplastic rubber, especially for extrusion or blow molding.

Injection Molding

All grades of Santoprene rubber are processed easily in injection molding equipment, producing dimensionally stable parts. Santoprene rubber flows well at high pressure, sets rapidly and releases freely from the mold. Part definition is excellent under normal operating conditions. Textured or inscribed surface detail is obtained readily.

Santoprene rubber has been run successfully on many makes and sizes of reciprocating screw injection molding machines. Machines should be sized for 40 to 70 MPa (3 tons to 5 tons per square inch) of clamping force per projected shot area. Preferably, the barrel capacity should contain less than six shots, although good results have been obtained with larger residence ratios. Typical molding temperature conditions are shown in Table VIII.

In a normal molding cycle for processing Santoprene rubber, the fill rate should be as rapid as possible, with the injection pressure and the speed at maximum to just short of flash. This is followed by a short holding time at a reduced pressure, sufficient to allow gate freeze-off. Cooling cycles of 20 to 30 seconds are common for 100g to 175g (4-ounce to 6-ounce) parts, with shorter cycles for small or thin-walled parts.

Screw speed should be 100 rpm to 200 rpm, and back pressure should be at a minimum, unless mixing is required. Santoprene rubber has excellent melt stability, which permits short cycle interruptions without purging. For idle periods longer than 20 minutes, it is recommended that the barrel be emptied.

When Santoprene rubber is molded properly, parts release freely from the mold. Thus, the use of mold-release agents is neither required nor recommended in normal operation.

Molding equipment should be cleaned thoroughly before and after processing Santoprene rubber. The injection unit should be mechanically cleaned or thoroughly purged with polyethylene or polypropylene.

For more detailed injection molding and tooling recommendations, request the AES "Injection Molding Guide for Thermoplastic Rubber."

TABLE VIII: Typical Temperature Conditions for Injection Molding of Santoprene® Thermoplastic Rubber[1]

Temperature in °C (°F)

		Grades of Santoprene Rubber								
		35A	45A	55A	64A	73A	80A	87A	400	500
Rear Zone	°C	200	175	185	195	195	195	195	195	195
(Feed)	(°F)	(390)	(350)	(370)	(380)	(380)	(380)	(380)	(380)	(380)
Center Zone	°C	204	185	195	200	200	200	200	200	200
	(°F)	(400)	(370)	(380)	(390)	(390)	(390)	(390)	(390)	(390)
Front Zone	°C	210	200	200	200	200	200	200	200	200
	(°F)	(410)	(390)	(390)	(390)	(390)	(390)	(390)	(390)	(390)
Nozzle	°C	216	205	205	205	210	210	210	210	210
	(°F)	(420)	(400)	(400)	(400)	(410)	(410)	(410)	(410)	(410)
Melt	°C	182-227	195-215	195-215	205-215	215-230	215-230	215-230	215-230	215-230
	(°F)	(360-440)	(380-420)	(380-420)	(400-420)	(420-440)	(420-440)	(420-440)	(420-440)	(420-440)
Mold	°C	"A" plate 46 "B" plate 27	10 - 80	10 - 80	10 - 80	10 - 80	10 - 80	10 - 80	10 - 80	10 - 80
	(°F)	"A" plate 115 "B" plate 80	(50-175)	(50-175)	(50-175)	(50-175)	(50-175)	(50-175)	(50-175)	(50-175)

1. See Disclaimer on inside front cover.

Extrusion

All grades of Santoprene rubber can be extruded to produce profiles, tubing, sheet or insulation and jacketing for wire and cable. In many cases, profiles can be extruded and size controlled without the need for vacuum sizing operations. The usual precautions in material handling should be observed to prevent contamination.

Extruders with length to diameter ratios of 24 to 1 greater are recommended for efficient processing of Santoprene rubber. General purpose, single-stage screws provide the best processing. Compression ratios of approximately 3 to 1 are recommended. Screen packs of 20-60 mesh are recommended. Typical extrusion temperature conditions are shown in Table IX. Screw cooling is NOT recommended.

To achieve good flow for filling out the die and to produce the best surface finish, medium-to-high screw rpm should be used.

It is best to maintain a melt temperature in the low end of the recommended range to achieve the best extrudate quality. If Santoprene rubber is not dried properly, porosity in the extrudate may result.

Material held in the extruder barrel during extended idle periods should be purged when starting up again. Extrusion equipment should be cleaned thoroughly before and after the processing of Santoprene rubber. The extruder barrel should be mechanically cleaned or thoroughly purged with polypropylene or polyethylene.

For more detailed extrusion processing and tooling recommendations, request the AES "Guide for Extrusion for Thermoplastic Elastomers."

TABLE IX: Typical Extrusion Temperature Profiles for Santoprene® Thermoplastic Rubber[1]

Temperature in °C (°F)

		Grades of Santoprene Rubber								
		35A	45A	55A	64A	73A	80A	87A	40D	50D
Feed[2]	°C	165	170	175	175	180	180	185	195	195
	(°F)	(330)	(340)	(350)	(350)	(360)	(360)	(370)	(380)	(380)
Zone 1	°C	170	175	180	180	185	185	195	200	200
	(°F)	(340)	(350)	(360)	(360)	(370)	(370)	(380)	(390)	(390)
Zone 2	°C	175	180	185	185	195	195	200	205	205
	(°F)	(350)	(360)	(370)	(370)	(380)	(380)	(390)	(400)	(400)
Zone 3	°C	180	185	195	195	200	200	205	210	210
	(°F)	(360)	(370)	(380)	(380)	(390)	(390)	(400)	(410)	(410)
Head	°C	185	195	200	200	205	205	210	215	215
	(°F)	(370)	(380)	(390)	(390)	(400)	(400)	(410)	(420)	(420)
Die	°C	185	195	200	200	205	205	210	215	215
	(°F)	(370)	(380)	(390)	(390)	(400)	(400)	(410)	(420)	(420)
Melt	°C	185	190	195	195	200	200	205	210	210
	(°F)	(365)	(375)	(385)	(385)	(395)	(395)	(400)	(410)	(410)

1. See Disclaimer on inside front cover.
2. If throat cooling (highly recommended) is not available, reduce feed zone temperature to 160 - 165°C (320 - 330°F)

Blow Molding

Santoprene rubber can be blow molded using either injection or extrusion blow molding equipment. Suggested operating parameters for extrusion blow molding are shown in Table X. Predrying is required.

Blow molding factors, such as mold design, parison dimension, cycle times and the uniformity of wall thickness, are all dependent on part geometry.

Excessive overheating of the melt will reduce the blow ratio for all grades of Santoprene rubber and should be avoided. All grades of Santoprene rubber exhibit low die swell, so choose die tooling very near to the desired parison diameter.

For grades softer than 64A, contact your AES representative or call for technical information.

TABLE X: **Typical Extrusion Blow Molding Parameters of Santoprene® Thermoplastic Rubber[1]**

Temperature in °C (°F)		Grades of Santoprene Rubber					
		64A	73A	80A	87A	40D	50D
Feed Zone	°C	170	175	190	195	195	195
	(°F)	(340)	(350)	(370)	(380)	(380)	(380)
Transition Zone	°C	180	190	195	200	200	200
	(°F)	(360)	(370)	(380)	(390)	(390)	(390)
Metering Zone	°C	190	195	200	205	205	205
	(°F)	(370)	(380)	(390)	(400)	(400)	(400)
Upper Head	°C	195	200	205	210	210	215
	(°F)	(380)	(390)	(400)	(410)	(410)	(420)
Lower Head	°C	195	200	205	210	210	215
	(°F)	(380)	(390)	(400)	(410)	(410)	(420)
Die	°C	200	200	205	215	215	215
	(°F)	(390)	(390)	(400)	(420)	(420)	(420)
Melt	°C	200	200	205	205	205	215
	(°F)	(390)	(390)	(400)	(400)	(400)	(410)
Mold Temperature	°C	5 - 40	5 - 40	5 - 40	5 - 40	5 - 40	5 - 40
	(°F)	(40 - 100)	(40 - 100)	(40 - 100)	(40 - 100)	(40 - 100)	(40 - 100)
Cycle Time (sec.)							
	Parison Drop	1 - 5	1 - 5	1 - 5	1 - 5	1 - 5	1 - 5
	Cooling	10 - 60	10 - 60	10 - 60	10 - 60	10 - 60	10 - 60
	Overall Time	15 - 90	15 - 90	15 - 90	15 - 90	15 - 90	15 - 90
Blow Speed							
		slow	slow	medium	fast	fast	fast
Blow Pressure							
	(MPa)	.3 - .6	.3 - .6	.4 - .7	.4 - .7	.4 - .7	.4 - .7
	(psi)	40 - 90	40 - 90	60 - 100	60 - 100	60 - 100	60 - 100
Screw Speed[2]							
	(rpm)	50 - 150	50 - 150	50 - 150	50 - 150	50 - 150	50 - 150
Blow Ratio[3]							
	(Max.)	2	2.5	3	4	4	5

1. See Disclaimer on inside front cover.
2. For continuous extrusion blow molding, screw speed will often be lower than 50 rpm. A polypropylene or polyethylene screw with a mixing section is recommended.
3. Part outer diameter / parison outer diameter.

Calendering

Santoprene rubber can be processed on thermoplastic calendering equipment to produce rubber sheet. Melt temperatures of 195°C to 220°C (380°F to 430°F) are recommended for the melt feed, with roll temperatures of 170°C to 195°C (340°F to 380°F). Actual processing conditions will depend on the equipment, the operating speed and the thickness of sheeting. Generally, extrusion is the preferred method for fabrication sheet from Santoprene rubber.

Using Regrind

You can regrind and reprocess clean runners, sprues or misprocessed finished product with virtually no loss of physical properties. Pre-drying of regrind is recommended prior to processing.

A grinder with a three-blade rotor and a low speed (100 rpm to 400 rpm) is recommended. A 10mm (0.40 in.) screen and a blade clearance of 0.1mm to 0.15mm (0.004 in. to 0.006 in.) is preferred.

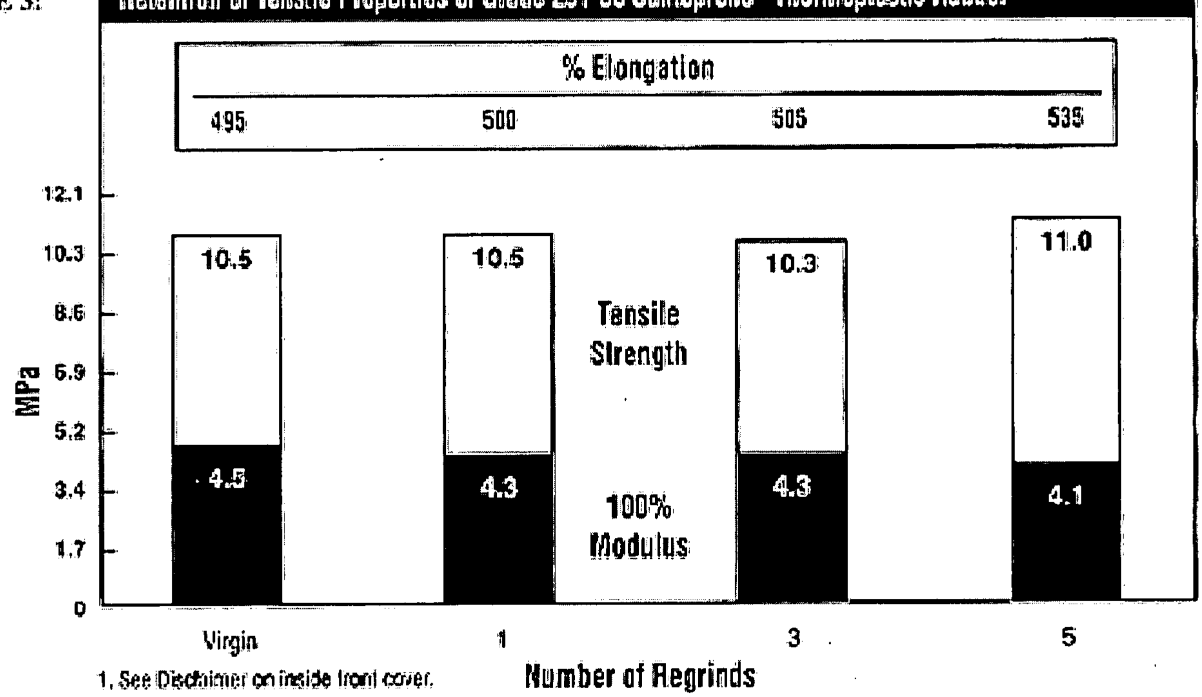
To minimize processing difficulties, the proportion of regrind should be limited to 20%, where practical.

Reprocessing does not significantly degrade Santoprene rubber. Figure 3 illustrates the properties of Santoprene rubber after one, three and five reprocessings in injection molding. The thermoplastic nature of Santoprene rubber permits as many as five injection molding reprocessings without major changes in ultimate tensile strength, 100% modulus and ultimate elongation. Other properties also are retained.

Secondary Processing

For processing recommendations on thermoforming, heat welding, adhesion, printing, blocking, etc., contact your AES representative or call the AES AnswerPerson℠ from 8:00 a.m. to 6:00 p.m. U.S. Eastern Time at 1-800-305-8070 or 1-330-849-5272.

FIGURE 3: Retention of Tensile Properties of Grade 201-80 Santoprene® Thermoplastic Rubber[1]



1. See Disclaimer on inside front cover.

Appendix B

ACADEMIC/CORPORATE **COLLABORATION**: RESPONDING TO CHA

By

Jo Ann Calzonetti, University of ***Akron***
Christopher Laursen, University of ***Akron****/Rubber Division, ACS*
Cathy Parker, University of ***Akron/Santoprene*** *Specialty Products*

The 2005 SLA Science & Technology Division contributed papers theme is "Coope to Survive and Flourish in the Modern Sci-Tech Library." The Corporate Services C (CSC) headquartered at The University of **Akron** (UA) is a collaborative effort betv corporate and non-profit organizations with a public university library to provide information services that allow all the partners to thrive and flourish, adding value t their respective organizations.

Introduction

The University of **Akron** is a public, metropolitan university that has a long history engagement with the surrounding community. The **Akron** community has a rich his of research, development and manufacturing of rubber and polymer products. A concentration of both large and small business firms and an internationally recogniz program at the University create synergy within the community. The commitment t community involvement and the synergistic research and business interests of the

community extend to the UA Libraries (Simons and Garten 1992; Williams 1994). Building on a fifty year partnership to provide library services to the Rubber Divisic (RD) of the American Chemical Society, the UA libraries began in 1996 systematic: developing a program of library services for the **Akron** business community. The initiative was supported by leadership from both the business community and the University. The UAL program reflects Guy St. Clair's (1996) description of entrepreneurial librarianship which includes risk taking, a 'start-up' mentality, innovation, commitment to continuous improvement, and adoption of new responsibilities to meet client's needs.

The initial goals of the program were to:

- Build collaborative collections
- Extend access to collections including OhioLINK
- Realize efficiencies through group purchasing
- Achieve recognition as a research center for polymer science and enginee and related disciplines
- Share searcher and subject expertise
- Provide cost effective training
- Become a "library for life" for students, corporate employees and researcl who live and work in the region

The services provided by the Center have expanded beyond these initial goals. In response to changing client needs, the CSC provides customized services that go be the scope of traditional library services. For example, CSC employees assist in man:

and marketing publications, creating and maintaining knowledge portals, and manag patent documentation and other intellectual property.

The CSC contracts to operate and manage library operations and provide other servi defined by client needs. Traditional library services including research, reference se and document delivery are provided to all CSC clients. The CSC client base has cha over time as companies merge and break apart or are bought and sold. This paper w

discuss two of the current CSC clients, **Santoprene** Specialty Products, an affiliate of ExxonMobil Chemical Company, and the Rubber Division of the American Chemic Society.

Santoprene Specialty Products, an affiliate of ExxonMobil Chemical Company

Santoprene Specialty Products has operated under several different corporate struct since it formation in 1991 as a joint venture by Monsanto (later Solutia) and Exxon Chemical (now ExxonMobil Chemical) to develop and market their technologies in thermoplastic elastomers. The company was then known as Advanced Elastomer Systems (AES). In 1995, AES moved into their current headquarters in **Akron**, Ohi take advantage of the concentration of industrial and **academic** focus on polymer ar rubber technology. Personnel from the two parent companies from various locations were brought together.

Experience with library and technical information services at Monsanto and Exxon Chemical created an expectation for research support within the new company. Libr research support along with shared equipment, student internships, and research **collaboration** became one of the collaborative opportunities negotiated by the Vice President of Technology of AES and University representatives from the College of Polymer Science and Engineering and the University Libraries. In 2002 ExxonMobi Chemical Company obtained Solutia's share of AES and in 2005 AES became **Santoprene** Specialty Products, an affiliate of ExxonMobil Chemical.

The University of **Akron** Libraries began providing library services to **Santoprene** AES) in 1996. The University Libraries recover all expenses incurred for the projec along with a percentage of overhead. Although the financial benefit for the Universi Libraries is modest, the good-will and cooperation the project has fostered far excee financial benefits.

The Corporate Service Center employees a librarian and a support staff member to onsite at **Santoprene**. In addition to traditional library services these contract emplo are fully integrated into the corporate mission and corporate values of **Santoprene**. Safety is an important cultural value and information center staff serve on the safety committee and publish the company's safety newsletter. Information center staff ha key responsibilities in management of **Santoprene**'s intellectual property by servin the patent committee and overseeing management of laboratory notebooks. They ar involved in the creation of a knowledge portal on the company's intranet to provide access to all of the company's internal knowledge products.

Future directions for the Information Center include records management, content management for the intranet, and competitive intelligence monitoring systems.

John H. Gifford Memorial Library, Rubber Division, ACS

The long history of the relationship between the RD Gifford Library and the UA Libraries has been recounted elsewhere (Long 1997). In addition to providing traditi library services, the librarian undertook the following initiatives during the past two to protect the Division's intellectual property and increase visibility for its publicati These initiatives include:

- Negotiating a royalty agreement between Rapra Technology and the RD for th sale of technical papers.
- Obtaining ISSN numbers for RD publications
- Registering RD publications with the Copyright Clearance Center.
- Submitting the RD's technical papers to new databases for indexing and abstracting.

The RD operates in part as a small publishing house and had been lax in seeking protection for its intellectual property. A new librarian hired in 2002 immediately identified several initiatives that would increase revenue to the Division from sale o publications.

Since 1974, Rapra was allowed to sell the RD papers with no royalty payment in exchange for indexing and abstracting the papers. In 2003 a new agreement was negotiated by the RD librarian. Beginning in 2004, Rapra pays a 50% royalty on eac paper sold.

Also in 2003 the librarian applied for ISSN numbers for the RD papers and educatic symposia. Upon receipt of the ISSN for each they were registered at the Copyright Clearance Center (CCC), the British Lending Library (BL) and Canadian Institute fo Scientific Information (CISTI) to facilitate the payment of copyright royalties to the

Three new database producers, Chemical Abstracts (CA), Applied Polymer Literatu (APOLLIT), and Cambridge Scientific Abstracts (CSA) agreed in 2003-2004 to inc RD publications in their databases thus increasing exposure of these publications.

All of these activities, the new agreement with Rapra, registration with the CCC, BI

CISTI and expanded indexing for RD publications, have increased revenue to the Division which enhanced perception within the Division of the value of the librariar

Additional efforts that are less directly tied to revenue enhancement were undertake the librarian to promote library services and Division activities. A library page was added to the RD Website. Several articles describing and promoting library services were published in rubber industry publications such as *Rubber World* and *Rubber Ir*

The librarian and the RD accountant worked together to automate all of the busines processes of the library.

Future innovations planned for the RD library include: selling RD papers via a secu website; moderating a listserv for rubber science and technology information; and developing partnerships with other rubber industry organizations and publications.

Conclusion

Clayton (1997) identifies four enabling characteristics for the implementation of innovation: 1.the attributes of the innovation itself; 2 the availability of resources; 3. characteristics of the organization; and 4. the contribution of leaders and other individuals. Of these four he states "the personal qualities and contributions of individuals were the crucial component" in a successful library innovation. The CS(experience supports this finding.

Senior level administrators from the University and corporate sector championed th partnership and this was and is critical to the CSC goal of expanding the program. T CSC librarians themselves are responsible for maintaining a commitment to innovat and the application of best practices by consistently scanning the environment for opportunities, proposing changes to streamline workflows, implementing new efficiencies, and adopting new methodologies. CSC librarians are successful in introducing innovations into their workplace because they are proactive, willing to t risks, and seek value added initiatives.

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To <Wayne_Vaz@Millipore.com>
cc <beate@unitargeting.com>, "Erlend Skagseth" <erlend.skagseth@sarsiaseed.com>, <Sapna_Mehtani@millipore.com>
bcc
Subject UTR's agreement w/ Prolume

Dear Wayne,
Please find attached a copy of UTR's agreement with Prolume Inc.

<<2079_001.pdf>>
We have blotted out the areas which we felt were not relevant with respect to the exercise at hand.
I think I have mentioned this to you previously but our involvement with Prolume actually began through the transfer of cDNA for the luciferase enzyme of several species including Gaussia (Appedix D to agreement) from Prolume to what at that time (year 2000) was the non-commercial precursor to UTR, the scientific group (which included Beate) at the University of Bergen. This transfer was governed by a Material Transfer Agreement which led to the assignment to Prolume of the IPR (listed in Schedule A of the (Millipore/UTR) evaluation agreement - Protein Expression System PCT/GB2004/002779) gained using the material provided by Prolume.

Drawing your attention to Article II of the agreement between UTR and Prolume, you can see that not only does Prolume grant exclusive rights to UTR for the commercial exploitation of the technology with the right to sublicense, but Prolume also grants UTR non-exclusive rights to Prolume'sportfolio of patents for use by UTR within the field of biomanufacturing.

Best regards,
Farzaad

–

All-
Thanks again for your comments today. I have actioned that:

- Erlend will provide a summary of the terms of UTR's licensing agreement w/ Prolume
- Ela Puchacz has already gone ahead and arranged a telecon to update Beate on the evaluation
- schedule next telecon early Dec

We will digest the info discussed today, continue our IP review and likely revert with additional questions sometime prior to the Dec meeting.

thank you,
wayne

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Applications

Block copolymers may possess unique and novel properties for industrial applications. During the past 20 years, they have sparked much interest; their potential has been realized in thermoplastic elastomers where the block copolymer is the principal constituent of the material and in applications where the block copolymer acts as a useful additive, eg, surfactants and viscosity improvers.

Several of the block copolymers have been commercialized and are available in the marketplace. Table 13 lists examples of common trade names and some typical applications, mainly of block copolymers produced in the U.S., Western Europe, and Japan. The most common uses of block copolymers are as thermoplastic elastomers, toughened thermoplastic resins, membranes, polymer blends, and surfactants.

Thermoplastic Elastomers. The most notable application of block copolymers is their use as thermoplastic elastomers which exhibit properties charac-

Table 13. Examples of Commercially Available Block Copolymers

Copolymer type	Trade names	Typical applications
Styrene–diene diblock S–B; S–I triblock S–B–S; S–I–S star block $(S–B)_x$	Solprene (Phillips) Kraton (Shell) Cariflex (Shell) Tufprene (Asahi) Europrene (Anic) Buna BL (Bayer) Eltar (Icechim-Romania)	thermoplastic elastomers, molding products, plastic modifiers, adhesives, films
Hydrogenated styrene–diene hydrogenated S–B–S styrene–(ethylene–butylene) styrene	Kraton G (Shell) Elaxar (Shell)	oxidation and weather-resistant thermoplastic elastomers, moldings, cable insulation
Segmented polyester–polyurethane thermoplastic polyurethanes (TPU)	Estane (Goodrich) Texin (Bayer, Mobay) Roylar (Uniroyal) Elastothane (Thiocol) Pellethane (Upjohn) Lycra (DuPont) Spandex (DuPont)	thermoplastic elastomers, fibers
Segmented polyester–polyether	Hytrel (DuPont) Pelprene (Toyobo) Arnitel (Akzo)	thermoplastic elastomers
Segmented polyamide–polyether	Pebax (Atochem) Vestamid E (C W. Huls)	molding extrusion, footwear, automotive parts, cable insulation
Polyolefinic block copolymers	TPR (Uniroyal) Somel (DuPont)	thermoplastic elastomers
Ethylene oxide/propylene oxide block copolymers	Pluronics, Tetronics (BASF Wyandotte)	surfactants

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teristic of chemically cross-linked elastomers, but differ from elastomers in that they soften and flow at elevated temperatures. The primary advantages of thermoplastic elastomers (TPEs) include easy processing with standard thermoplastic processing equipment, low processing cost compared to conventional rubbers, the possibility of recycling, the large variety of thermal, rheological, and mechanical properties, and their transparency, hence greater possibility of color selection. Production figures for the main thermoplastic elastomers are given in Table 14.

Table 14. Consumption of Thermoplastic Elastomers, 10^3t/yr[a]

Type of TPE	Year of commercialization	World 1979	Western Europe 1979	U.S. 1979	U.S. 1981	U.S. 1986[b]
styrenics	1965	130	57	55	70	107
olefinics	1972	40	15	19	28	51
polyesters	1972	5	1	4	6	11
polyurethanes	1959–1960	40	15	19	21	29
other		≈1	0.5	0.5	0.5	1
Total		*216*	*88.5*	*97.5*	*125.5*	*≈200*[c]

[a] Refs. 482, 483, and 484
[b] Ref. 3.
[c] Forecast 400 according to ref. 2

The typical elastomeric properties of these materials can be attributed to physical cross-linking resulting from domain formation in the case of triblock and multiblock copolymers having hard and soft segments. The hard segments are so designed that they remain incompatible with the rubber phase, thus forming discrete microdomains which act as physical cross-links at service temperatures. At elevated temperatures, these domains dissociate, enabling the material to flow under the conditions used in thermoplastic processing.

The first commercially available thermoplastic elastomers were polyurethanes (TPUs), formed of long flexible polyether or polyester chains linked by polar polyurethane units, which associate into microdomains by hydrogen bonding. These substances have excellent strength, wear, and oil resistance, and are used in fibers, footwear, automotive bumpers, snowmobile treads, adhesives, etc (see also POLYURETHANES, BLOCK COPOLYMERS).

Styrenic thermoplastic elastomers were introduced in 1965 by Shell under the trade name Kraton, and include SBS and SIS triblock copolymers. These block copolymers, with typical styrene contents of 25–40 wt %, are either of the pure block type or tapered (overlap) structures. In addition, the desired balance between hard (polystyrene) and rubbery (polydiene) segments and linear or branched structures with different molecular weights leads to products with various characteristics. Their uses include footwear (67%), bitumen modification (14%), plastics modification by thermoplastics blending (6%), adhesives (9%), and cable insulation and gaskets (4%). The percentages are the U.S. market share in 1980 (2,3,482–484). In Western Europe use in bitumen modification is higher (23%) and in footwear correspondingly lower (58%).

Styrenic types with saturated midblocks (hydrogenated polybutadiene or polyisoprene) have been developed as second-generation products having excel-

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lent weatherability Like olefinic TPEs, the saturated materials are suited for wire and cable sheeting and automotive applications. These TPEs, such as polystyrene-*block*-poly(ethylene–butylene)-*block*-polystyrene, introduced by Shell, possess high cohesive strength, retain structural integrity at higher temperatures, and have excellent resistance to degradation by oxygen, ozone, and uv light.

A significant proportion of the present consumption of butadiene–styrene block copolymers is in the form of oil-extended grades. The dilution of both the linear SBS type and star $(S\text{–}B)_n$ thermoplastic elastomers with mineral oils serves the dual purpose of improving certain mechanical and rheological properties and increasing the cost efficiency of the product Typical compositions of these oil-extended grades are 45–60 parts of oil per 100 parts of elastomer; these materials have been reviewed (485,486).

Polyether–polyester TPEs have flexible polyether chains which are cross-linked by crystallization of the polyester groups. Applications of such block copolymers based on poly(butylene terephthalate) and poly(tetramethylene oxide) have been reviewed (406); they include hose, tubing, sport goods, mechanical items, and automotive components Their typical polymer properties include relatively high load-bearing capacity, high flexural fatigue endurance, low and high temperature performance, good chemical and weathering resistance, and easy and efficient processing The effect of solid state extrusion on the morphology of such thermoplastic elastomers has been described (487).

Various *polyolefinic block copolymers* useful as thermoplastic elastomers have been described (488). Ethylene–propylene block copolymers have received the most attention. New patents on such TPEs have recently been reported (489,490).

Polyether–polyamide block copolymers are the newest TPEs developed and have the schematic structure

$$\mathrm{HO}\!\left(\underset{\displaystyle\overset{\|}{\mathrm{O}}}{\mathrm{C}}\!-\!\mathrm{PA}\!-\!\underset{\displaystyle\overset{\|}{\mathrm{O}}}{\mathrm{C}}\!-\!\mathrm{O}\!-\!\mathrm{PE}\!-\!\mathrm{O}\right)_{n}\!\mathrm{H}$$

where PA is a polyamide segment and PE is a polyether segment.

These products have been commercialized by C.W. Huls and by Ato Chimie, and it is claimed that they have wider application than the older TPEs (491,492). The use of polyether–polyamide block copolymers in thermoplastic polyamide compositions has been reported (493).

Shortcomings of polyurethane, polyester, and styrene–diene block copolymers include oxidative, hydrolytic, and thermal instability. In addition to polyolefinic TPEs and various hydrogenated block copolymers (494), new products are being developed for use in extreme environments. Some of these experimental thermoplastic elastomer block copolymers include poly(α-methylstyrene)-*block*-polybutadiene-*block*-poly(α-methylstyrene) (495); poly(α-methylstyrene)-*block*-polyisobutylene-*block*-poly(α-methylstyrene) (121,496); a series of polydimethylsiloxane multiblock $(A\text{–}B)_n$ copolymers, having hard blocks like polyarylethers, polyarylesters, polyarylcarbonates, polystyrene, and poly(α-methylstyrene) (464); and block copolymers based on cellulose derivatives (497).

The various thermoplastic elastomers have been described from both the basic and applied point of view in an ACS Symposium proceeding (498) (see also ELASTOMERS, THERMOPLASTIC).

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